SCHEME OF INSTRUCTION& EXAMINATION
B.E. – VII SEMESTER(CIVIL ENGINEERING)
AICTE MODEL CURRICULUM(for 2018-2022 & 2019-2023 Batches)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC401CE**	Construction Engineering and Management	3	-	-	3	30	70	3	3
2	**PC402CE**	Prestressed Concrete	3	-	-	3	30	70	3	3
3	**PE**	Professional Elective - IV	3	-	-	3	30	70	3	3
4	**PE**	Professional Elective - V	3	-	-	3	30	70	3	3
5	**OE**	Open Elective - II	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	**PR401CE**	Seminar*	-	-	4	4	25	-	3	2
7	**PW401CE**	Project - I	-	-	4	4	50	-	-	**2**
			15	**-**	**8**	**23**	**225**	**350**		**19**

*Technical Report and Seminar / based on summer industrial Internship/Mini Project

Professional Elective – 4			Professional Elective – 5		
S. No.	**Course Code**	**Course Title**	**S. No.**	**Course Code**	**Course Title**
1	**PE401CE**	Design of Concrete Structures - II	1	**PE405CE**	Advanced Steel Design
2	**PE402CE**	Urban Transportation Planning	2	**PE406CE**	Retrofitting and Rehabilitation of Structures
3	**PE403CE**	Surface Hydrology	3	**PE407CE**	Highway Construction and Management
4	**PE404CE**	Disaster Mitigation and Management	4	**PE408CE**	Geographic Information Systems and Remote sensing

Open Elective – II		
1	**OE421 ME**	Entrepreneurship (Not for Mech/Prod Engg students)
2	**OE402 CE**	Green Building Technologies (Not for Civil Engg students)
3	**OE402 CS**	Data science using R (Not for CS students)
4	**OE403 IT**	Cyber security (Not for IT students)
5	**OE402 EE**	Transducers And Sensors (Not for EEE & EIE Students)

Course Code	Course Title						Core / Elective
PC 401 CE	**CONSTRUCTION ENGINEERING AND MANAGEMENT**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Nil	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Impart knowledge of project management systems and construction scheduling
- Introduce with the techniques involved in the optimization of project resources
- Familiarize with health and safety on project sites and BIM for project managers

Course Outcomes

After completing this course, the student shallbe able to:

- Apply current construction practices in the management of infrastructure projects
- Implement various techniques for scheduling of construction projects
- Apply resource optimization in construction projects using available software
- Implement BIM to improve quality, reduce costs, and time in construction process
- Formulate and apply LP model to optimize time-cost in construction projects

UNIT – I

Introduction: Introduction to Construction projects – objectives and lifecycle, existing construction practices &project management systems, Project scale, Project Team, organization, roles, responsibilities, Management Ethics (human aspects) in construction projects, Labor welfare, applicable labor legislations.

UNIT – II

Construction Management through Network Theory: Definitions and different types of Event, activity, dummy, Network rules, Network event numbering (Fulkerson Rule), Hierarchies of complex network, work break down structure, Liner Scheduling methods - bar charts, milestone charts, LOB, their limitations, difference between PERT and CPM, network based scheduling techniques - PERT, CPM, AON and AOA in construction management- Numerical Problems.

UNIT –III

Cost & Resource Optimization Techniques: Cost Model - Direct and Indirect Cost component of Project, Cost Slope, Project Cost-Time analysis and optimization. Resource usage profile, Histograms, Project up dating, Introduction to Project management software

UNIT – IV

Project Monitoring & Control - Safety, Health and Environment on project sites, accidents their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, basics of modern project management systems such as lean construction, use of Building Information Modelling (BIM) in project management

UNIT – V

Linear programming and optimization in construction: Introduction to optimization – Linear programming, Importance of optimization in construction, Simple problems on formulation of LP, Graphical method, Simplex method, Case studies

Suggested readings

1. Gahlot. P.S. and Dhir. B.M., "Construction Planning and Management", Wiley Eastern Ltd., 2018.
2. Sidney Levy., "Project Management in Construction", Seventh Edition, McGraw-Hill Education, 2017.
3. Seetharaman S., "Construction Engineering and Management", Umesh Publications, 2012.
4. Punmia, B. C., and Khandelwal, K. K., "Project planning and control with PERT and CPM", 2006.
5. Chitkara, K. K. "Construction Project Management: Planning, Scheduling and Controlling", Tata McGraw–Hill Education, 2004.
6. Srinath L.S., "PERT and CPM: Principles and Applications", East-West Press, 2001

Course Code	Course Title						Core/Elective
PC 402 CE	**PRESTRESSED CONCRETE**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Reinforced Cement Concrete	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the basic concepts of prestressed concrete, materials used and load balancing.
- Study the flexural and shear design of prestressed concrete beam sections and design of beams.
- Learn to evaluate the deflections and design the end blocks of prestressed concrete sections.

Course Outcomes

After completing this course, the student will be able to

- Apply the concept of prestressing and determine the losses of prestress.
- Analyse the prestressed concrete beam and suggest the cable profile for beam.
- Design the prestressed concrete beam for flexure and shear.
- Analyse the prestressed continuous beam and determine the concordant cable profile.
- Estimate the deflection of a prestressed concrete beam and design the end block.

UNIT – I

Introduction to Prestressed Concrete: Historical development, principles of pre stressed concrete. Definition, classification and systems of prestressing. Materials for pre stressed concrete.

Loss of pre stress: Losses of pre stress in pre-tensioned and post-tensioned members.

UNIT – II

Analysis of Pre stress: Basic assumptions, analysis of pre stress, resultant stress, pressure line, kern points, cable profiles, load balancing concept, stress diagrams for pre stress, dead load and live load.

UNIT – III

Simply Supported Continuous Beams: concordant cable profile, analysis of continuous pre stressed concrete beams.

Design of Sections: Flexural strength design of rectangular, I and T sections using IS code provisions.

UNIT – IV

Design for Shear: Basic concept of shear design, shear failure, flexural shear failure, shear compression failure, shear tension failure, shear strength of beams (a) unfrocked in flexure and (b) cracked in flexure.

UNIT – V

Deflections: Necessity of deflection estimation, limitations of deflections. Deflections of pre-stressed concrete beams with uniformly distributed and point loads.

End Block: Types of end blocks and Importance of end block, Analysis and design of end block by Guyon method and IS method for not more than two cables.

Suggested Readings:

1. T.Y. Lin and N.H. Burns, *Design of prestressed concrete structure*, Jon Wiley and Sons,1982.
2. A.H. Nilson, *Design of Prestressed Concrete*, John Wiley and Sons,1982.
3. N. Krishna Raju, *Design of prestressed concrete structure*, Tata McGraw Hill Book Co.,1996.
4. G.S. Pandit and S.P. Gupta, *Prestressed Concrete*, CBS Publishers,1995.

Course Code	Course Title						Core / Elective
PE 401 CE	**DESIGN OF CONCRETE STRUCTURES - II**						**PE -IV**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DCS- I	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the design concepts of concrete structures like deep beams and shear walls.
- Understand the design principles and methods for Bunkers and Silos.
- Learn the various types of R.C.C bridges and their design procedures.

Course Outcomes

After completing this course, the student will be able to

- Analyse and design an Intze water tank, a canonical bottom water tank and a deep beam
- Apply the concepts of shear walls in selection of their design parameters
- Analyse and design square and circular bunkers and cylindrical silos.
- Analyse and Design the R.C.C Deck type bridge.
- Analyse and Design a Tee Beam bridge for IRC Loading

Unit –I

Water Tanks: Analysis and Design of Intze Water Tank, and Circular Water Tank with Canonical bottom.

Deep Beams: Introduction, Analysis and design of Deep Beam for flexure. Shear in deep Beams.

Unit – II

Shear walls: Introduction, classification of shear walls, types of loads, introductory analysis and design concepts

Unit – III

Bunkers and Silos: Introduction - Design principles and theories Code provisions - design ofsquare and circular bunkers - design of cylindrical silos. IS specifications.

Unit – IV

Design of RCC Slab Bridges: IRC loadings, Elastic Design and Detailing of RC bridge deck slab using effective width methods.

Unit – V

Design of RCC T Beam Bridges: Use of Pigaud's curves for the design of slab. Design and detailing of Cross beams and Tee Beam of a Tee beam bridge.

Suggested Reading:

1. David Darwin, Charles W. Dolan, Arthur H. Nilson, “Design of Concrete Structures”, 15th Edition, McGraw Hill, 2016.
2. Krishna Raju, N., “Structural Design and Drawing: Reinforced Concrete”, Universities Press, 2009.
3. Johnson Victor, D., “Essentials of Bridge Engineering”, Oxford & IBH Publishing, 2019.
4. Krishna Raju, N., “Design of Bridges”, Oxford & IBH Publishing; 5th edition, 2019
5. Praveen Nagarajan, “Design of Concrete Bridges: As per latest IRC Codes”, Wiley Publishing, 2020
6. P.C. Vargese, “Advanced Reinforced Concrete Design,” PHI publishing, 2005
7. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures,” PHI publishing, 2006

Course Code	Course Title						Core /Elective
PE 402 CE	**URBAN TRANSPORTATION PLANNING**						**PE -IV**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Transportation Engineering	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Objectives:

The objectives of this course are to:

- Familiarize with urban transportation systems planning process and its components
- Review various travel surveys and data collection procedures
- Study of various components of travel demand forecasting in transportation planning process

Outcomes:

After completing this course, the student will be able to:

- Classify various urban transportation issues and planning methodologies
- Design, conduct and administer surveys to provide the data required for transportation planning.
- Supervise the process of data collection about travel behavior and analyze the data for use in transport planning.
- Develop and calibrate modal split, trip generation rates for specific types of land use developments.
- Adopt the steps that are necessary to complete a long-term transportation plan.

UNIT – I

Urban Transportation Problems and Planning Process: Role of transportation - Transportation problems - Urban travel characteristics – Systems approach to transportation planning - Transportation Survey and Analysis: Definition of study area - Zoning - Types and sources of data - Road side interviews - Home interview surveys.

UNIT – II

Trip Generation Analysis: Concept of travel demand - Demand function - Independent variables - Travel attributes -Trip generation models - Zonal models - Category analysis - Household models - Trip attractions of work centers.

UNIT – III

Trip Distribution Analysis: Introduction – Methods of trip distribution – Uniform factor method – Average factor method - Trip distribution models - Growth factor model - Gravity model –- Opportunity model.

UNIT – IV

Modal Split Analysis: Introduction – Factors affecting modal split – Modal split in transportation planning process- Probit analysis – Logit analysis – Mode choice behaviour.

UNIT – V

Route Assignment Analysis – Introduction – Assignment techniques - All-or-nothing assignment – Multiple route assignment - Capacity restraint assignment - Diversion curves.

Suggested Reading:

1. Papacostas,'Fundamentals of Transportation Planning', PHI Learning Pvt. Ltd., New Delhi, 2009.
2. Khisty C.J., 'Transportation Engineering – An Introduction' Prentice Hall. New Delhi, 2008
3. Kadiyali, L. R. "Traffic Engineering and Transport Planning", Khanna Publishers, New Delhi, 2006
4. Bruton M.J., 'Introduction to Transportation Planning', Hutchinson and Company (Publishers) Limited, England, 1985.
5. Hutchinson, E.G., "Principles of Urban Transport Systems Planning", McGraw Hill, Inc., USA, 1974.

Course Code	Course Title						Core / Elective
PE 403 CE	**SURFACE HYDROLOGY**						**PE -IV**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Understand the formation of water resources, sediment movement in rivers and stream flow measurement.
- Describe the flood routing techniques, mitigation measures and application of statistical methods.
- Explain the concept of urbanization and its impact on the natural water cycle.

Course Outcomes:

- Able to apply the knowledge of soil erosion and sedimentation to estimate the life of the reservoir
- Demonstrate concept of flood routing techniques and suggest suitable flood control measures.
- Estimate stream flows.
- Develop relationship between hydrological variables.
- Able to understand the planning and operation of Urban water management.

UNIT – I

Formation of surface water Resources-Streams, rivers, lakes, swamps, caves, seas and oceans: Definition of river, river basins and water divides, formation of river valleys, fluvial deposits, alluvial fans, meandering of rivers, formation of different types of lakes, deltas and valleys.

Sediment discharge, Sediment transport, Sediment yield of watersheds, suspended load and bed load measurements, reservoir sedimentation-sediment movement and deposition, reduction in reservoir capacity, reservoir sedimentation control.

UNIT – II

Flood Routing- Introduction, basic equation, Hydrologic storage routing, attenuation, Hydrologic channel routing, Hydraulic methods of flood routing.

Flood Control- Structural and non-structural methods, flood control in India, national and state bodies involved for mitigation and management of floods as a natural disaster.

UNIT – III

Stream flow Measurement – Stage and Velocity Measurement – Gauges – Current meter and Doppler flow velocity meter - Discharge measurement – direct methods (Area-Velocity method, Dilution techniques, electromagnetic method, ultrasonic method), indirect methods (Slope-area method, discharge measuring Structures(weirs, flumes and gated structures),Stage-Discharge relationship , Selection of a Stream Gauging Site.

UNIT – IV

Statistics in Hydrology- Introduction, Statistical parameters, central tendency parameters, dispersion characteristics, skewness, probability distribution, discrete and continuous distribution, frequency analysis, log Pearson type III distribution, regression and correlation, standard forms of bivariate equations, multivariate linear regression and correlation, analysis of time series, selection of a design return period, determination of permissible risk.

UNIT – V

Urban Water Management-urban hydrology, major issues in urban storm water management, objectives and limitations, airport drainage design, urban water resource management models, urban storm water management practices, rainwater harvesting.

Suggested Reading:

1. Chow V.T., Maidment D.R., Mays L.W., "*Applied Hydrology*", McGraw Hill Publications, New York, 1995.
2. Subramanya K., "*Hydrology,Tata McGraw Hill Co*., New Delhi, 1994.
3. Patra.K.C, "*Hydrology and Water Resources Engineering*",Narosa Publications, 2008, 2nd Edition, New Delhi.
4. Jay Rami Reddy.P, "*Hydrology*", Laximi Publications, New Delhi, 2004
5. Raghunath H.M., "*Hydrology*", New Age International Publishers, New Delhi, 2014.
6. Martin, P. Wanelista and Yousef, A. Yousef., *Storm Water Management*, John Wiley and sons,1993
7. Jay L.Devore, "*Probability and statistics for Engineering and the Sciences*", 5th Edition, Thomson and Duxbury, Singapore, 2002

Course Code	Course Title						Core / Elective
PE 404 CE	**DISASTER MITIGATION AND MANAGEMENT**						**PE -IV**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Objectives:

- Learn about the basic principles of disaster management and the types of disasters
- Understand the disaster management cycle and framework.
- Know about the disaster management systems in India and the applications of the latest technologies in disaster management

Outcomes:

After completing this course, the student will be able to

- Apply the concepts of disaster management to evaluate a disaster situation.
- Classify the various categories of disasters and their specific characteristics.
- Select appropriate pre-disaster, during disaster and post-disaster measures and framework
- Identify the disaster management acts and frameworks specific to India relevant to a situation
- Identify a suitable technological application to aid disaster management.

UNIT-I

Introduction: Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, and Capacity – Disaster and Development, and disaster management.

UNIT-II

Disasters:Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

UNIT-III

Disaster Management Cycle and Framework: Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness.

During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation.

Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR.

UNIT-IV

Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter Governmental Agencies.

UNIT-V

***Applications of Science and Technology for Disaster Management*:** Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India.

Suggested Reading:

1. Rajib, S and Krishna Murthy, R. R, *Disaster Management Global Challenges and Local Solutions"* CRC Press, 2009.
2. Navele, P & Raja, C. K, *Earth and Atmospheric Disasters Management, Natural and Manmade. B. S. Publications, 2009*
3. Bhattacharya, T., *Disaster Science and Management*. Tata McGraw hill Company, 2017
4. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
5. *An overview on natural & man-made disasters and their reduction*, R K Bhandani, CSIR, New Delhi
6. *Disaster Management Act 2005*, Publisher by Govt. of India

Course Code	Course Title						Core/Elective
PE405CE	**ADVANCED STEEL DESIGN**						**PE - V**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Steel Structures	**3**	**-**	**-**	**-**	**30**	**70**	**3**

CourseObjectives

- Understand the basic concepts of welded plate girder design.
- Learn the basic principles of gantry girder design.
- Study the various types of bridges, bridge bearings and their design procedures.

CourseOutcomes

After completing this course, the student will be able to

- Analyse and design the Welded plate girder.
- Analyse and design of gantry girder.
- Design of Roller and Rocker Bearing for the bridge.
- Design a Deck type Plate girder railwaysteelbridges.
- Analyse and Design a Truss Girder Bridge.

UNIT–I

Plate Girders: Design of welded plate girders for static loads, connections, intermediate and bearing stiffeners, web and flange splices.

UNIT–II

Gantry Girders: Basic principles, codal provisions and detailed design.

UNIT–III

Bearings: Types and materials, detailed design of bearings for bridges.

UNIT–IV

Bridges: Deck and trough type bridges, economical span, bridge rules(Railway Board, Ministry of Railways)

Plate Girder Bridge: Detailed designof plategirderbridges

UNIT–V

Truss Girder Bridge: Detailed design of truss girder bridges

***SuggestedReadings*:**

1. N.Subramanyam, *Design of Steel Structures*,Oxford University Press,2008.
2. B.C.Punmia, *Comprehensive Design of Steel structures*,Laxmi Publishers,2001.
3. P.Dayaratnam, *Design of steel Structures*, S.Chand & Company Ltd, 2003.
4. N.Krishna Raju, *Design of Bridges*,Oxford and IBH Publishers,NewDelhi,1998.
5. Relevant *I.S.Code books* on Design of Steel Structures.

Course Code	Course Title						Core / Elective
PE 405 CE	**RETROFITTING AND REHABILITATION OF STRUCTURES**						**PE -V**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**		**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Understand the basic concepts of building maintenance, the causes, mechanisms and prevention of deterioration in structures.
- Study the methods of condition assessment of structures and associated non-destructive techniques.
- Know the materials, methodology and techniques of repair, and retrofitting of structures.

Course Outcomes:

After completing this course, the student will be able to

- Select an appropriate building repair and maintenance method for a specified deterioration in structures.
- Differentiate the types of defects, damage and explain the various deterioration mechanisms in structures.
- Choose an appropriate non-destructive test and a condition assessment procedure for a given structure.
- Apply the knowledge of repair materials and techniques for choosing a rehabilitation process for a distressed structure.
- Choose a suitable retrofitting and rehabilitation procedure for a deteriorated and distressed structure.

.

UNIT –I

Introduction to Building Maintenance*:* Definitions of repair, renovation, remodelling, restoration, retrofitting and rehabilitation. Need for maintenance, types of maintenance, routine maintenance works in buildings.

Types of Defects and Damages in Structures: During pre-construction stage, construction stage and post construction stage. Cracks – Types, Causes and Characteristics

UNIT –II

Mechanisms of Deterioration of Structures & Their Prevention*:* Concrete Structures: Defects in fresh concrete- Early frost damage, plastic shrinkage, plastic settlement (subsidence), subgrade settlement, formwork movements. Deterioration in hardened concrete: (a) Physical causes - aggregate shrinkage, drying shrinkage, crazing (b) Chemical causes: acid attack, sulphate attack, chloride attack, carbonation, alkali aggregate reaction, corrosion of reinforcement, (c) Thermal causes: Freeze-thaw, temperature variations, differential thermal expansions, humidity influences, (d) Structural causes: improper design loads, accidental overloads, creep

Steel Structures Corrosion: Causes and types of deterioration, mechanism of corrosion, prevention of deterioration.

UNIT –III

Condition Assessment and Non-destructive Testing & Evaluation*:* Definition, objectives and stages of condition assessment Destructive and partially destructive tests. Non-destructive tests (NDTs). Classification of NDT procedures, Visual Inspection, Ultrasonic Testing methods (Impact echo, Pulse velocity, Pulse echo), Rebound hammer (IS 13311), Windsor probe test, Half-cell potential measurement, Electrical resistivity measurement, Carbonation depth measurements, Petrographic Analysis, Electromagnetic methods for Rebar detection, Ground Penetrating radar, Infrared thermography, Radiography,

UNIT – IV

Repair Materials and Techniques*:* Repair Methodology, Repair materials (cement-based, polymer-based, resin based, microcrete, composites, etc.), compatibility considerations, Repair techniques: Using mortars, dry pack, epoxy bonded pack, pre-placed aggregate concrete, gunite, shotcrete, grouting, polymer impregnation, resin injection, routing & sealing, stitching, surface patching, overlays & surface coatings, autogenous healing, gravity filling, drilling and plugging.

UNIT – V

Retrofitting & Rehabilitation Procedures**:** Strengthening of Existing Structures – Overview, general procedures, Techniques: section enlargement, composite construction, post-tensioning, stress reduction, strengthening by reinforcement, methods of strengthening in beams, slabs, columns (plate bonding, RC jacketing, FRP methods, concrete overlays, etc.) strengthening of substructure (shoring, underpinning)

Suggested Readings

1. Handbook on *"Repair and Rehabilitation of RCC Buildings"*, Published by Director General, CPWD, Govt. of India, 2002.
2. Varghese P. C. (2015), *Maintenance, Repair & Rehabilitation & Minor Works of Buildings*, PHI Learning Pvt. Ltd, Delhi.
3. Modi P.I. and Patel C.N. (2016), *Repair and Rehabilitation of Concrete Structures*, PHI Learning Pvt. Ltd, Delhi.
4. Peter H. Emmons and Gajanan M. Sabnis (2001), *Concrete Repair and Maintenance Illustrated*, Galgotia Publications, New Delhi.
5. SP: 25-1984, (1999), *Handbook on Causes and Prevention of Cracks in Buildings*, BIS, New Delhi.
6. Guide Book on *Non-destructive Testing of Concrete Structures*, Training course series No. 17, International Atomic Energy Agency, Vienna, 2002.

Course Code	Course Title						Core / Elective
PE 407 CE	**HIGHWAY CONSTRUCTION AND MANAGEMENT**						**PE -V**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Transportation Engineering	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Understand the material characterization for the use in pavement construction
- Review of various soil stabilized pavement layers
- Study of components of pavement distress evaluation and pavement management systems

Course Outcomes:

After completing this course, the student will be able to:

- Implement the method of construction and field control check for flexible pavement layers.
- Develop QA/QC procedures for monitoring the quality of pavement construction
- Perform mix design to identify the bearing capacity of soil stabilized pavement layers
- Apply modern devices for functional and structural evaluation of pavements
- Develop performance prediction models for pavement management systems

UNIT – I

Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers and their choice.

UNIT – II

Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints

UNIT – III

Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil-aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and applications.

UNIT – IV

Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Pavement distress survey, Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - nondestructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques.

UNIT – V

Pavement Management Systems - Pavement Management Systems Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques– AASTHO, CRRI and HDM models, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, lifecycle costing.

Suggested Reading:

1. Yoder E.J, and Witczak M. W., "Principles of Pavement Design", John Wiley & Sons, 1975.
2. Kadiyali and Lal, "Principles of Highway Engineering", Khanna Publishers, New Delhi, 2006
3. Haas and Hudson W.R., "Pavement Management Systems", McGraw Hill Inc., USA, 1978.
4. Frank Harris, "Modern Construction Equipment & Methods", John Wiley & Sons, 2006
5. IRC related Codes for Flexible and Rigid Pavements design.

Course Code	Course Title						Core / Elective
PE 408 CE	**GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING**						**PE -V**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Surveying &Geomatics	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

The objectives of the course are:

- Learn the fundamental concept of Remote Sensing and know about different types of satellite and sensors
- Understand the concepts of GIS and its applications
- Learn to work with GIS software in various application fields

Course Outcomes:

At the end of this course, the student will be able to:

- Classify different types of satellites and sensors used in remote sensing
- Illustrate the energy interactions with earth surface features and their spectral properties
- Demonstrate the basic concept of GIS and its applications, know different types of data representation in GIS
- Create the spatial data using various techniques
- Develop models using Spatial & Terrain Analysis

UNIT – I

Basics of Remote Sensing: Definition, History, Advantages, Aerial Photography and Satellite Remote Sensing, Components of Remote Sensing System: Energy Source, Energy-Atmosphere Interaction, Energy Interaction with Atmosphere and Surface Materials, Spectral Signatures

UNIT – II

Remote Sensing Platforms: Aircrafts and Satellites, Orbital Characteristics of Sun-synchronous and Geostationary satellites - Special Purpose Satellites; Remote Sensing Sensors: Types of Sensors, Active and Passive; Framing Systems (Cameras) - Scanning System; Sensor Characteristics: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.

UNIT – III

Introduction to GIS: History of development of GIS- Geo Spatial Data - GIS operations- Standard GIS packages, Applications of GIS;

Datum and Map Projections: Concept of Datum, Coordinate Systems and Map Projections , Transformations

UNIT – IV

Data Models: Spatial and Non-Spatial Data models; Spatial Digital formats

Spatial Data Creation: Scanners, digitizers; Digital Elevation Models; Sources of Errors & Corrections- Rotation and Resampling methods.

Spatial Data Analysis: Raster data analysis; Vector data analysis - Buffering, Overlay, Union, Intersect, Merging, splitting operations

UNIT – V

Terrain Modelling & Analysis: Contouring, Vertical profiling, Hill shading, 3D perspectives; Slope & Aspect analysis, Viewshed & watershed analysis. **Software:** Introduction to QGIS or ARCGIS software.

Suggested Reading:

1 Chang, K. T. (2016). Geographic information system. *International Encyclopedia of Geography: People, the Earth, Environment and Technology*, 1-10.

2 Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). *Remote sensing and image interpretation*. John Wiley & Sons.

3 Reddy, M. A., & Reddy, A. (2008). *Textbook of remote sensing and geographical information systems* (pp. 4-4). Hyderabad: BS publications.

OPEN ELECTIVE – II

Course Code	Course Title						Core / Elective
OE421ME	**ENTREPRENEURSHIP**						**OE -II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise & project management
- To understand the design principles of solar energy systems, their utilization and performance evaluation
- To understand the behavioral aspects of entrepreneurs and time management

Course Outcomes:

At the end of the course, the students will be able to

- Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Smal and Large Scale Industries, Types and forms of enterprises.
- Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs Conception and evaluation of ideas and their sources.
- Practice the principles of project formulation, Analysis of market demand, Financial an profitability analysis and Technical analysis.
- Apply the concepts of Project Management during construction phase, project organizatio project planning and control using CPM, PERT techniques
- Understand the Behavioral aspects of entrepreneurs, Time Management,Various approache of time management, their strengths and weakness. The urgency addiction and tim management matrix.

Unit-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

Unit-II:

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

Unit-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

Unit-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of

tax burden.

Unit-V

Behavioral aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behavior. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Reading:

1.Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House,1997

2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata McGraw-Hill Publishing Company Ltd. 1995.

3. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.

4. G.S. Sudha, "Organizational Behaviour",1996.

5. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd., 5lh Ed.,2005.

Course Code	Course Title						Core / Elective
OE402CE	**GREEN BUILDING TECHNOLOGIES**						**OE-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Learn the principles of green building technologies and rating systems
- Understand the principles of effective energy and resources management in buildings
- Understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes:

After completing this course, the student will be able to

- Classifythevarious features, benefits, and rating systems for a green building
- Outline the criteria used for site selection and water efficiency methods
- Select the energy efficiency techniques in designing a green building
- Select materials for sustainable built environment & adopt waste management methods
- Identifyan appropriate methodfor maintaining indoor environmental quality in a green building

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials (c) use of materials with recycled content such as blended cements materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Well being: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment
3. 'Alternative building materials and technologies' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. 'Non-Conventional Energy Resources' by G. D. Rai, Khanna Publishers.
5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004

Course Code	Course Title						Core / Elective
OE402CS	**DATA SCIENCE USING R**						**OE-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To learn basics of R Programming environment: R language, R- studio and R packages.
- To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting.
- To learn Decision tree induction, association rule mining and text mining.

Course Outcomes:

Student will be able to

- Use various data structures and packages in R for data visualization and summarization.
- Use linear, non-linear regression models, and classification techniques for data analysis.
- Use clustering methods including K-means and CURE algorithm

UNIT – I

Introduction To R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling Packages in R.

Getting Started With R: Introduction, Working with Directory, Data Types In R, Few Commands for Data Exploration.

Loading and Handling Data In R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment In R, Using _As' Operator To Change The Structure Of The Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation And Group Processing Of A Variable, Simple Analysis Using R, Methods For Reading Data, Comparison Of R GUI's For Data Input, Using R With Databases And Business Intelligence Systems.

UNIT – II

Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values And Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.

UNIT – III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression?, Introduction To Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.

UNIT – IV

Decision Tree: Introduction, What Is A Decision Tree?, Decision Tree Representation In R, Appropriate Problems For Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search In Decision Tree Learning, Inductive Bias In Decision Tree Learning, Why Prefer Short Hypotheses, Issues In Decision Tree Learning.

Time Series In R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT – V

Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K-Means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.
Association Rules: Introduction, Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.
Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, Text Mining Verses Data Mining, Text Mining In R, General Architectures of Text Mining Systems, Pre-Processing of Documents In R, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages.
Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods.
Frequent Itemset, Closed Itemset And Association Rules.
Frequent Itemset: Mining Methods, Pattern Evaluation Methods, Sentiment Analysis**.**

Suggested Readings:

1. Data Analytics using R by Seema Acharya. McGraw Hill education.
2. Practical Data Science with R, Nina Zumel and John Mount, Manning Shelter Island.
3. 'The R book, Crawley, Michael J. John Wiley & Sons, Ltd

Course Code	Course Title						Core / Elective
OE403-IT	**CYBER SECURITY**						**OE-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Objectives:

- To familiarize various types of cyber-attacks and cyber-crimes
- To give an overview of the cyber laws
- To study the defensive techniques against these attacks

Outcomes:

Student will be able to

- Understand different types of cyber-attacks
- Understand the types of cybercrimes and cyber laws
- To protect them self and ultimately the entire Internet community from such attacks

UNIT – I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance –Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT – II

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains-medical, financial.

UNIT – III

Logical Design: Blue print for security. Security Policy, standards and Practices, Design of Security Architecture.

Physical Design: Security Technology, Physical Design of Security SDLC Firewalls, Dialup Protection, Intrusion Detection Systems, Scanning and analysis tools, and Content filters.

UNIT – IV

Cryptography: The basic elements of cryptography: symmetric (Symmetric Key-DES, IDEA, and AES), and public key cryptography (Public Key Encryptions-RSA).

UNIT – V

Message digest (MD-5, SHA), and digital signatures.

SSL and SET: SSL and SET protocols, Internet transactions using both SSL and SET.

Suggested Readings:

1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", Thomson, 2003.
2. William Stallings, "Cryptography and Network Security", Pearson Education, 2000.
3. Nina Godbole, "Information System Security", John Wiley & Sons, 2008.

Course Code	Course Title						Core / Elective
OE402EE	**TRANSDUCERS AND SENSORS**						**OE-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers.
- To introduce advances in sensor technology

Course Outcomes:

At the end of the course students will be able to

- Familiar with the basics of measurement system and its input, output configuration of measurement system.
- Familiar with both static and dynamic characteristics of measurement system.
- Familiar with the principle and working of various sensors and transducers

UNIT-I

Introduction to measurement system (MS) static characteristics of MS: linearity, Hysteresis, Threshold, Repeatability, Reliability and maintainability, Span, Calibration. Sensor Fundamentals: Basic sensor technology and sensor system Sensor characteristics, system characteristics, instrument selection, data acquisition and readout, and installation.

UNIT-II

Resistive Transducer: Classification of transducers, Basic requirements of transducers, Variable resistance transducers; Potentiometers, Strain gauge (SG), types of Strain Guage.

UNIT-III

Variable capacitive transducers: Capacitance, Principles, Capacitance displacement transducers, Capacitive hygrometer, and capacitive proximity transducers. Variable inductive transducers: Linear variable differential transformer, Rotary variable differential transformer.

UNIT - IV

Measurement of temperature: Standards for calibration of temp. Temperature measuring devices, types of filled in system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistance temperature detectors, thermostat thermocouple.

UNIT – V

Advance Sensors: Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

Suggested Readings:

1. C.S.Rangan, G R Sarma& V S N Mani, Instrumentation Devices and Systems-TMH, 2nd Edition2004.
2. B.Nakra&Chowdhari, Instrumentation Measurement and Analysis, TMH, 2nd Edition 2003

3. D.V.S.Murthy, Transducers and Instrumentation, PHI, 1995 4. John P. Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education,2000.
4. Doebelin E.O, Measurement Systems - Application and Design, 4th Edition, McGrawHill, New Delhi.
5. PatranabisD, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill, New Delhi,1997.
6. Jon Wilson Sensor Technology Handbook, Newness PublicationElsevier.

Course Code	Course Title						Core / Elective
PR 401 CE	**SEMINAR (Based upon Summer Internship/ Mini Project)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	-	**-**	**-**	**2**	**25**	**-**	**2**

Course Objectives:

- Analyze a current topic of professional interest by conducting literature survey.
- Summarize and present the topic before an audience.
- Acquire skills in technical report writing

Course Outcomes:

After completion of this course the students will be able to:

- Understand the current needs of the industry.
- Understand techniques, processes and tools used in the industry.
- Prepare technical report on an industrial project
- Realize the importance of self-learning
- Present the technical experience at an industry or through the mini-project to a peer audience.

Course Plan

Seminar

Each student shall identify a topic of current relevance in his/her branch of engineering, get approval of faculty concerned, collect sufficient literature on the topic, study it thoroughly, prepare own report and presenting the class.

Evaluation

(Evaluation of Technical Report should be based on the progress reported by the student and certified by the supervisor)

Seminar:25marks	Activity	**Weightage**
Distribution of marks	Presentation	**10**
	Ability to answer questions	**8**
	Report	**7**

Note: Two progress evaluations, mid semester and end semester, are mandatory
Allevaluationsaremandatoryforcoursecompletionandforawardingthefinalgrade.

Internship Guidelines (S*election of Summer Internships)*

1. Students should opt for summer internship that would provide to gain ample field knowledge in the relevant field of engineering such that theoretical knowledge gained in the class can be applied to solve the practical/ field problem.
2. Students should take a challenging task, may be small portion, and apply the knowledge gained to solve it. Summer internship can also involve data collection from different sources including generating experimental data, collection of data from field etc. Later on the student is required to analyze the data collected and arrive at meaningful conclusions.
3. Summer internship shall be aimed at solving some of the problems of the society/ local region that should have practical applications and benefit the society.

4. Students should devote full 3-4 weeks for summer internship. If any student undergoes internship duration is less than 3-4 weeks, such interns shall not be considered. If any credits are given to the internship program then student must register as per the course registration process.
5. Different central and state government organizations, CSIR labs, premier institutions like IITs and IIMs, DRDO, public sector undertaking organizations, top IT companies, skill enhancement centers recognized by state or central governments, research labs and Industries (small scale to large scale) can be considered for summer internships.
6. Students of individual institutions/colleges are permitted to undertake internships in their own campuses. However, in house (own campuses) internships are permitted with the prescribed guidelines.
7. Head of the department should allocate faculty members as advisors for all VI students at the end of V semester for advising the students in selecting proper summer internship. Entire process should complete by 31st March of every year.
8. Head of the department should depute faculty members for monitoring the student summer internship by communicating to the company guide.
9. The internship done by the student is assessed in two stages. i) External evaluation for 30 marks and internal evaluation for remaining 20 marks. HoD should constitute summer internship evaluation committee consisting of department faculty members that may include one faculty from other dept. The evaluation committee should involve in the evaluation process. Committee can take decision to reject the student summer internship if it doesn't meet the requirements of summer internships. Such students have to repeat the summer internship.
10. Individual department should send the recommended student list to the academic section/training and placement cell of the individual institution/college by second week of March for further proceedings. The list should contain the student basic details, concern faculty details, research areas, expected outcome of the internships. For this to happen, the students should submit the request letter through single window application processing system for further proceedings from the department and academic section/ training and placement cell.
11. It is the responsibility of the concern faculty to monitor the day-to-day academic activities of their students. If any student found misbehaving, misconduct during summer internships (particularly during academic hours) and upon receipt of the complaint, immediately the disciplinary action shall be initiated against the student and faculty concerned should submit a report.
12. Maximum number of students allowed per faculty shall be decided by the individual department in consultation with Academic section.

Course Code	Course Title						Core / Elective
PW 401 CE	**PROJECT WORK - I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	-	**-**	**-**	**-**	**50**	**-**	**2**

Course Objectives:

- To develop skills in doing literature survey.
- To encourage students to work with innovative and entrepreneurial ideas.
- To enable project identification and execution of preliminary works on final semester project.

Course Outcomes:

- Analyze a current topic of professional interest and present it before an audience
- Identify an engineering problem, analyze it and propose a work plan to solve it
- Develop awareness of design methodologies & its implementation
- Acquire skills in technical report writing
- Prepare a preliminary report and present it before an audience.

Project preliminary:

Identify suitable project relevant to the branch of study. Form project team (not exceeding four students). The students can do the project individually also. Identify a project supervisor. Present the project proposal before the internal departmental committee comprising of Head of the Department, faculty coordinator, faculty supervisor(s) and at least two faculty members (excluding the external expert) and get it approved by the committee.

The preliminary work to be completed:

(1) Literature survey
(2) Formulation of objectives
(3) Formulation of hypothesis/design/methodology
(4) Formulation of work plan (5) Seeking funds
(6) Preparation of preliminary report

Note: The same project initiated in Project Work-I should be continued and completed in the VIII semester as Project Work –II by the same project team.

Evaluation

Evaluation of Project-1 should be based on the progress reported by the student and certified by the supervisor. Evaluation is done based on the students presentation, twice in the semester ie. mid semester evaluation and end semester evaluation. Sessional marks are awarded by the evaluation committee comprising of two faculty members and the supervisor. Marks are allotted based on the students presentation, Report preparation and students ability to answer the questions raised by the examiners.

Distribution of marks	Activity	Weightage
Mid semester evaluation (25)	Supervisor	**10**
	Examiners	**15**
End semester evaluation (25)	Supervisor	**10**
	Examiners	**15**

Note: Two progress evaluations, mid semester and end semester, are mandatory. All evaluations are mandatory for course completion and for awarding the final grade.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Civil Engineering) VIII– SEMESTER
AICTE MODEL CURRICULUM (for 2018-2022 & 2019-2023 Batches)

S. No.	Course Code	Course Title	Scheme of Instruction			Scheme of Examination		Credits
			L	T	Pro/ Drg	CIE	SEE	
Theory Courses								
1	MC	Gender Sensitization	2	-	-	30	70	-
2	PE	Professional Elective – VI	3	-	-	30	70	3
3	PE	Professional Elective - VII	3	-	-	30	70	3
4	OE	Open Elective -III	3	-	-	30	70	3
Practical/ Laboratory Courses								
5	PW 704 CE	Project Work - II	-	-	12	50	100	**6**
			8	**-**	**12**	**170**	**380**	**15**

Open Elective – III		
1	OE605 EE	Smart Building Systems (Not for EEE & EIE Students)
2	OE606 EE	Programmable Logic Controllers (Not for EEE & EIE Students)
3	OE631 AE	Automotive Maintenance (Not for Mech./Prod./Automobile Engg. students)
4	OE631 ME	Mechatronics (Not for Mech./Prod./Automobile Engg. students)
5	OE603 CE	Road Safety Engineering (Not for Civil Engg. Students)
6	OE604 IT	Software Engineering (Not for IT Students)

Professional Elective – 6			**Professional Elective – 7**		
S.No	**Course code**	**Course title**	**S.No**	**Course code**	**Course title**
1	**PE409CE**	Finite Element Techniques	1	**PE413CE**	Concrete Technology
2	**PE410CE**	Principles of Climate Change	2	**PE414CE**	Water and Air quality
3	**PE411CE**	Principle of green buildings	3	**PE415CE**	Intelligent transportation systems
4	**PE412CE**	Construction Equipment and Automation	4	**PE416CE**	Infrastructure Engineering

Course Code	Course Title						Core/Elective
MC901 CE	**GENDER SENSITIZATION**						**Mandatory**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**-**

Course Objectives

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- Information about some key biological aspects of genders.
- Reflect critically on gender violence.
- Exposure on egalitarian interactions between men and women.

Course Outcomes

After completing this course, the student will be able to

- Developabetterunderstandingofimportantissuesrelatedtogenderincontemporary India.
- Sensitize to basic dimensions of the biological, sociological, psychological and legal aspects ofgenderthroughdiscussionofmaterialsderivedfromresearch,facts,everydaylife,literatureandfilm.
- Getafinergraspofhowgenderdiscriminationworksinoursocietyandhowtocounterit.
- Better equipped to work and live together as equals.
- Develop a sense of appreciation of women in all walks of life.

UNIT–I

Understanding Gender: Why should we study it? Socialization: making women, making men. Introduction, preparing for womanhood, growing up male, first lessons in caste, different masculinities, just relationships, being together as equals, Mary Kom and Onler, Love and acid just do not mix, love letters, mothers and fathers, Further reading: RosaParks- the brave heart.

UNIT–II

Gender and Biology: Missing women, sex selection and its consequences, declining sex ratio, demographic consequence, gender spectrum, beyond the binary, two or many, struggles with discrimination, our bodies, our health.

UNIT–III

Gender and Labor: Housework, the invisible labor, my mother doesn't work, share the Load, women's work, its politics and economics, fact and fiction, unrecognized and unaccounted work, wages and conditions of work.

UNIT–IV

Issues of Violence: Sexual harassment - Say No!: Sexual harassment, no eve teasing, coping with everydayharassment,"Chupulu"domesticviolence,speakingout,ishomeasafeplace?Whenwomenunite,rebuilding lives, new forums for justice, thinking about sexual violence, blaming the victim, I fought for my life, the caste face of violence.

UNIT–V

Gender Studies Knowledge: Through the lens of gender, point of view, gender and the structure of knowledge. Unacknowledged women artists of Telangana: Whose history? Questions for historians and others :reclaiming a past, writing other histories, missing pages from modern Telangana history.

Suggested Readings:

1. A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu, Towards a World of Equals: A Bilingual Text book on Gender, Telugu Akademi, Hyderabad, 1st Edition, 2015

PROFESSIONAL ELECTIVES

Course Code	Course Title						Core / Elective
PE 409 CE	**FINITE ELEMENT TECHNIQUES**						**PE -VI**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Structural Analysis I&II	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

The objectives of this course are:

- Understand the numerical finite element modelling of 3D structural problemswith linear and non-linear models.
- Understand the analysis of various loads and displacements relations both for a local element and the global assembly of a structure.
- Perform the numerical analysis for simple problems the procedure for which is same in solving complex problems using high-end computer oriented numerical analysis tools.

Course Outcomes

After completing this course, the student will be able to:

- Formulate the matrix equations for constitutive relationships for 2D and 3D structural elements in plane stress and plane strain problems.
- Formulate the stiffness matrices for various structural elements.
- Formulate global stiffness matrix and load matrix along with assigning appropriate boundary conditions using suitable domain discretization
- Solve for the unknown nodal parameters using Gauss quadrature techniques and interpolating shape functions for Iso-parametric finite elements
- Formulate the Stiffness Matrix, Stress-Strain relationships and boundary conditions for axisymmetric problems.

UNIT - I

Introduction to Finite Element Method: Introduction**,** Stress and Equilibrium. Boundary conditions. Strain – Displacement relations. Stress – strain relations. One Dimensional Problems: Finite element modeling coordinates and shape functions. Plane stress and plane strain problems.

Unit – II

Stiffness Matrix: Stiffness matrix for two noded bar, truss, and beam elements, problems with three degrees of freedom. Transformation, generation of stiffness matrix for frames

Variational approach, Rayleigh-Ritz and Galerkin's methods.

UNIT – III

***Formulation of Finite Element Method*:** Using principle of virtual displacement. Determination of stiffness matrix for three noded triangular element (constant strain triangle), and four noded rectangular element for plane stress and plane strain problems. Convergence criteria for selection of displacement models. Discretisation of continuum. Assembly of global stiffness and load matrices. Displacement boundary conditions.

UNIT – IV

***Isoparametric Finite Elements*:** Direct construction of shape functions for higher order

elements using natural co-ordinate system. Shape functions for eight noded parabolic curved iso-parametric element. Determination of element stiffness matrix for four noded quadrilateral element. Use of Jacobian, and Gauss quadrature techniques. Load matrix for eight noded rectangular isoparametric element (for body forces and surface traction).

UNIT – V

***Strain Displacement*:** Stress – strain relation for axisymmetric problems. Stiffness matrix for three noded ring element, Volume co-ordinates and stiffness matrix for four noded tetrahedron element. Exposure to FEM based softwares.

Suggested Readings:

1. O.C. Zienkiewicz and R.L. Taylor, *The Finite Element Method*, Vol. I, McGraw Hill,1989.
2. K.J. Bathe, *Finite Element Procedures*, Pearson Education,2006.
3. S. M. Jalaludeen, *Finite Element Analysis*, Anuradha Publications,2016.
4. T.R. Chandrupatla, *Finite Element Analysis for Engineering and Technology*, Universities Press, 2004.
5. C.S.Krishnamoorthy, *Finite Element Analysis, Tata Mcgraw Hill publishing Company.2014*

Course Code	Course Title						Core / Elective
PE 410 CE	**PRINCIPLES OF CLIMATE CHANGE**						**PE -VI**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- Understand basic concepts of general circulation Models and their importance.
- Know the features of Indian Summer Monsoon Rainfall (ISMR) and their characteristics.
- Understand the downscaling principles of statistical downscaling and dynamical downscaling.

Course Outcomes:

At the end of the course, the student will be able to:

- Classify and illustrate the various elements of the climate system.
- Identify the various elements of global water balance and causes of instability.
- Analyze the indicators that affect the monsoon and drought conditions
- Make use ofmodels of climate change using various causative parameters and statistical tools.
- Apply the statistical tools for bias correction and data downscaling on general circulation models of climate change.

UNIT – I

Climate System: Weather and Climate- Overview of earth-atmosphere- vertical structure of atmosphere- - Heat Balance of Earth Atmosphere- Radiation and temperature- Temperature variation- Laws of Radiation, Radiation Balance- variation with latitude

UNIT – II

Introduction of Global water balance: cycling of water on land- role of water cycle-simple water balance, climate variables affecting precipitation- Precipitation and Weather, Humidity, Vapour Pressure atmospheric stability-causes of instability-classification of clouds-precipitation process

UNIT – III

Monsoon: Global wind circulation- clouds- Types of Clouds-Indian summer monsoon Rainfall (ISMR)- characteristics- Inter-annual variability- Floods- droughts- drought Indicators- climate extremes.

UNIT – IV

Causes of Climate Change: Impacts of climate change on Hydrology-Modelling of climate change-IPCC scenarios- IPCC Assessment Report (AR5)-physical science basis- Coupled Model Inter-comparison Project (CMIP)- CMIP5 data downloading procedure- Reanalysis data products.

UNIT – V

General Circulation Models: Bias correction methods -Downscaling – Types of downscaling- Dynamical downscaling- Regional Climate Models - concepts of statistical downscaling- data reduction techniques - principal component analysis-application of Regression methods.

Suggested Reading:

1. Bonon G B (2008) - *Ecological Climatology*- Cambridge University Press Edition- II
2. RL Wilby, SP Charles, E Zoritaa, B Timbal, PW Hetton, LO Mearns (2004) -*Guide lines for use of climate science from Statistical Modeling models*.
3. *Physical science basis of AR 5 report of IPCC (2013)*- working group I contribution to Assessment Report- https://ipcc.ch/report/ar5/wg1/
4. Rasmus E Benestad, Inger Hanson Baver, Delinag Chen (2008) *Empirical Downscaling World*, Scientific Publishing Co. Ltd.
5. Vente Chow (1964)- *Hand Book of Applied Hydrology*- - Mc Graw Hill Co.

Course Code	Course Title						Core / Elective
PE 411 CE	**PRINCIPLES OF GREEN BUILDINGS**						**PE -VI**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- Learn the principles of green buildings and the available green rating systems for buildings in India and abroad.
- Understand the principles of sustainable development adopted in green buildings through reduce, recycle and reuse strategy in conserving natural resources and energy.
- Understand the principles of landscape preservation, water conservation, energy efficiency, building resources management and indoor air quality in green buildings

Course Outcomes:

After completing this course, the student will be able to

- Outline the various features and benefits of a green building and classify the various parameters used in green rating systems
- Evaluate a building using the green rating criteria for site selection and water efficiency
- Identify the energy efficiency parameters and methods used in green building practices
- Select materials for sustainable built environment & adopt waste management methods
- Apply the various methods for maintaining indoor environmental quality in green buildings

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof,Design principles of ground recharge type and storage type rainwater harvesting methods,reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Well being: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.
Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. *IGBC Green Homes Rating System*, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers
2. GRIHA version 2015, GRIHA rating system, *Green Rating for Integrated Habitat Assessment*
3. '*Alternative building materials and technologies*' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. '*Non-Conventional Energy Resources*' by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual*, Vol.1 and 2, TERI, New Delhi 2004

Course Code	Course Title						Core/Elective
PE 412 CE	**CONSTRUCTION EQUIPMENT AND AUTOMATION**						**PE -VI**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

•Introduce construction equipment and its effective utilization using scientific principles
•Identify construction equipment and its association with different construction works
•Attain knowledge in equipment selection for various activities involved in construction.

Course Outcomes:

- Apply the working procedures of various excavating and earth moving equipment
- Apply various equipment needed for compaction, erection, drilling and demolition
- Understand working procedures of material handling and production equipment.
- Identify and apply automation systems and fire safety equipment in construction sites
- Analyze the various processes of HVAC & Security

UNIT – I

Equipment for Earthwork: Fundamentals of Earth Work Operations- Earth Moving Operations - Types of Earth Work Equipment –Excavation equipment- Power Shovels, Back Hoe, Drag line, Clamshell – Excavating and Earth Moving Equipment – Scrapers, Bull Dozers, Tractors, Hauling Equipment– Dump trucks, Dumpers Loaders, trucks.

UNIT – II

Equipment for Earth Compaction-Tamping Rollers, Smooth Wheel Rollers, Sheeps foot Roller, Pneumatic- tyred Roller, Vibrating Compactors, Vibro compaction methods.

Other construction equipment: Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting-Equipment for Compaction- Erection Equipment- Types of pumps used in Construction-Equipment for Dewatering and Grouting– Foundation and Pile Driving Equipment – Equipment for Demolition, Road making equipment.

UNIT – III

Equipment for material handling - Crushers – Feeders - Screening Equipment – Material handling equipment - Cranes, Hoists, Forklifts and related equipment - Portable Material Bins –Conveyors – Hauling Equipment.

Equipment for aggregate production and concreting- Batching and Aggregate Mixing Equipment-Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment–Ready mix concrete equipment, Concrete mixers, Concrete batching and mixing plant, Transportation of concrete mix, Concrete Pouring and Pumping Equipment, Concrete compaction equipment.

UNIT – IV

Introduction to building automation systems (BAS) - Concept and application of Building Automation System, requirements and design considerations and its effect on functional efficiency, architecture and components of BAS.

Fire alarmsystem (FAS) standards- Fundamentals: Fire modes, Components, and Principles of Operation. FAS Components: Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. FAS Architectures, loop, Examples. Fire Standards: IS Concept of fire &alarm system..

UNIT – V

Access control security systems-Access Control System: Components, Design. CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, Network design, Storage design. Components.Security Systems, Concepts, Components, Technology, Advanced Applications, Security system design.

Heating, ventilation & air conditioning system- HVAC basic processes, Air Properties, Psychometric Chart, Heat Transfer mechanisms, Human comfort zones, Effect of Heat, Humidity, Heat loss. Heating Process & Applications, Cooling Process & Applications, Ventilation Process & Applications. Instrumentation Basics, Field components & use. Air conditioning Components.

Suggested Reading:

1. R.L.Peurifoy, "Construction Planning and Equipment" Tata McGraw-Hill Education; 9th Edition, 2018.
2. Mahesh Varma .Dr., "Construction Equipment And Its Planning And Application", Metropolitan Book Company, New Delhi, 2003
3. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, Delhi, 2008
4. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers Delhi, 2008
5. Gagnon. R. "Design of Special Hazards and Fire Alarm Systems", Thomson Delmar, NY, US, 2007
6. Levenhagen, Spethmann. J.I, Donald . "HVAC Controls and Systems", McGraw-Hill, SG, 1994

Course Code	Course Title						Core / Elective
PE 413 CE	**CONCRETE TECHNOLOGY**						**PE -VII**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Objectives:

- Understand the behavior of fresh and hardened concrete.
- Learn the design of concrete mixes as per IS, ACI and British Standards
- Know about the precast technology and its uses.

Outcomes:

After completion of this course, the student will be able to:

- Evaluate concrete quality based on its properties at fresh stage and hardened stage
- Interpret the effects of creep and shrinkage on concrete durability and illustrate the microstructure of concrete with all its phases.
- Design the concrete mix using IS code method, British code and ACI code method.
- Identify the use of special concretes based on their properties in different situations.
- Classify the various components of precast technology and the various types of prefabricated components.

UNIT – I

Properties of Fresh Concrete and Hardened Concrete: Review of the physical properties of Concrete, Workability- Factors affecting workability- workability tests. Water/Cement ratio, Segregation and Bleeding of concrete. Mixing and vibration of Concrete. Strength of concrete, Factor effecting strength of concrete. Abram's Law, Gel space ratio. Compressive strength, Flexural Tensile strength, Split tensile strength, Pull out strength , Modulus of Elasticity and Poisson's ratio of Concrete. Method of determining these strength and relevant IS code Provisions.

UNIT –II

Durability of concrete – Factors affecting durability. Creep of concrete- Factors influencing creep- Relation between creep & time- Nature of creep-Effects of creep-Shrinkage-types of shrinkage.

Microstructure of concrete – significance- complexities- Aggregate phase – Hydrated cement phase – Interfacial transition zone – Dimensional stability

UNIT – III

Mix Design: Factors in the choice of mix proportions- Quality Control of concrete- Statistical Quality control- Acceptance criteria- Proportioning of concrete mix – IS method of mix design – British and ACI method of mix design

UNIT - IV

Special Concretes: High strength concrete, Ferro cement mass concrete, light weight concrete, high density concrete, polymer concrete self-compacting concrete, nano concrete recycled aggregate concrete, geo-polymer concrete fiber reinforced concrete shotcrete, reactive powder concrete.

UNIT – V

Introduction To Precast Technology

Need for prefabrication – Principles – Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection.

Prefabricated Components

Behavior of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Suggested Reading:

1. A. M. Neville , "PropertiesofConcrete,"5th edition, Pearson, 2011
2. M. S. Shetty and A. K. Jain, "Concrete Technology: Theory and Practice," S.Chand& Co., 2018
3. M. L. Gambir, "Concrete Technology: Theory and Practice" Tata Mc Graw Hill Publishers, New Delhi, 2017
4. P. K. Metha and J. M. Monteiro, "Concrete: Microstructure, Properties and Materials," Tata Mc-Graw Hill Education, 2017
5. CBRI, Building materials and components, India, 1990
6. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
7. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009
8. "Handbook on precast concrete buildings," Indian Concrete Institute (ICI), Chennai, 2016.

Course Code	Course Title						Core / Elective
PE 414 CE	**WATER AND AIR QUALITY MODELING**						**PE -VII**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- Understand modelling concepts.
- Describe air quality and water quality models.
- Explain computer-based simulation and various software's.

Course Outcomes:

- Classify modelling techniques, models based on mass conservation and mass balance
- Classify and describe the parameters involved in various air quality models
- Formulate the various water quality models.
- Develop linear programming models and other optimization techniques to estimate the air and water quality.
- Gain knowledge of and explain the features of various software related to air and water quality modelling.

UNIT – I

Modeling Concepts: Casual and statistical models-characteristics-steps in model development-importance of model building conservation of mass and mass balance-calibration and verification of models.

UNIT – II

Air Quality Modeling

Modelling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Metrological Modelling – Diagnostic Models -Prognostic Models – diffusion models, modifications of Gaussian plume equation -long term average- receptor oriented and source oriented air pollution models ,Numerical Models, model performance, accuracy and utilization.

UNIT – III

Water Quality Models

Mass balance equation -Mathematics of Pollutant Transport – Advection- dispersion-In-Water Transformation- Waste load allocations – Basic mechanisms of river self-purification, Dissolved Oxygen dynamics Streeter-Phelps and Dobbins models, Pollutant and nutrient dynamics, Temperature dependence and transport, Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants – Ground Water Quality Modelling – Contaminant solute transport equation, Numerical methods.

UNIT – IV

Computer Based Simulation

Formulation of linear optimization models. Linear programming. Sensitivity testing and duality. Solutions techniques and computer programming, Formulation of linear optimization models. Finite difference finite element method of pollutant dispersion- Optimization river pollutant and management models finite element method of pollutant dispersion-optimization river pollutant and management models-Application of models- simulation, parameters estimation of

experiment design. Model uncertainty reliability.

UNIT – V

Software

Air quality Model -ARMOD, CALPUFF. – UNAMAP- BLP-RAM-ISCMPTER-CRSTER- Surface water quality models -HSPF, QUAL2K,.

Suggested Reading:

1.Deaton, M.L and Winebrake, J.J., Dynamic Modelling of Environmental Systems, Verlag, 2000.

2. Chapra, S.C. Surface Water-Quality Modelling, McGraw-Hill, 2008.

3.Arthur C. Stern., Air Pollution (Third Ed.) Volume I – Air Pollutants, their transformation and Transport, (Ed.), Academic Press, 2006.

4.Wainwright, J and Mulligan, M., Environmental Modelling Finding simplicity in complexity, John Wiley and Sons Inc., New York, 2013

5.Dykes, A.P., Mulligan, M., and Wainwright, J, Monitoring and Modelling dynamic environment, Wiley – Blackwell 2015.

6.Paolo Zanetti, Air Pollution Modelling – Theories, computation Methods and available Software Springer. New York, 1990

7.Benedini G. Tsakiris Water Quality Modelling for Rivers and streams Springer , New York , 2013

Course Code	Course Title						Core / Elective
PE 415 CE	**INTELLIGENT TRANSPORTATION SYSTEMS**						**PE -VII**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Transportation Engineering	**3**	**-**		**-**	**30**	**70**	**3**

Course Objectives:

The objectives of this course is to

- Understand ITS & ATIS
- Know the functional areas of ITS such as ATMS, CVO, AVCS and APTS, ARTS
- Study of ITS architecture and its applications

Course Outcomes:

After completing this course, the student will be able to:

- Plan and specify the requirements using ITS
- Plan and management aspects for ITS
- Prepare architecture and application for ITS
- Illustrate the functional areas of ITS and their user needs and services
- Explain the overview of ITS in highway incident management systems

UNIT – I

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT – II

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.

UNIT – III

ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

UNIT – IV

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

UNIT – V

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.Traffic and incident management systems – ITS and sustainable mobility, travel demand management, electronic toll collection.

Suggested Reading:

1. Ghosh, S., Lee, T.S., “Intelligent Transportation Systems: New Principles and Architectures”, CRC Press, 2000
2. Chowdhury, M. A., Sadek, A. and Boston, M.A., “Fundamentals of Intelligent Transportation Systems Planning”, Artech House, Inc., USA, 2003
3. Joseph, S.S., “Perspectives on Intelligent Transportation Systems”, Springer publishers, USA, 2008
4. Sussman, J. M., “Perspective on ITS”, Artech House, Inc., USA, 2005

Course Code	Course Title						Core / Elective
PE 416 CE	**INFRASTRUCTURE ENGINEERING**						**PE -VII**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Transportation Engineering	**3**	**-**		**-**	**30**	**70**	**3**

Course Objectives

- Examine the power sector infrastructure requirements including maintenance issues.
- Review various infrastructures needs of roads, railways, water ways and airports
- Discuss various communication systems and postal services infrastructure requirements.

Course Outcomes

- Demonstrate the understanding of the power sector infrastructure needs and maintenance strategies.
- Evaluate the public & private sector role in infrastructure development
- Develop strategies for Infrastructure Planning and its Implementation
- Implementation of environmental laws and regulations

  Demonstrate the understanding of the strategies for successful implementation of infrastructure projects

UNIT-I

An Overview of Infrastructure Engineering: Urban Infrastructure and Rural Infrastructure in general. An Introduction to Special Economic Zones, Organizations and Players in the field of Infrastructure, The Stages in an Infrastructure Project, Concept of Lifecycle., etc., An Overview of Infrastructure Projects in power Sector, Water Supply and Sanitation Sector, Road, Rail, Air and Port Transportation Sectors and Telecommunications.

UNIT-II

Public and Private Sector Role in Infrastructure Development: A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization , Challenges in Privatization Water Supply, Power, Infrastructure, Road Transportation Infrastructure in India, BOOT, BOT, DBFOT, PPP,HAM -Case studies preferable.

UNIT-III

Infrastructure Planning and Implementation: Mapping and Facing the Landscape of Risks in Infrastructure Projects, Core Economic and Demand Risks, Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure – Case studies preferable.

UNIT-IV

Environmental and Social Impact Assessment Aspects: categories, attributes and parameters, identification of environmental and social impacts over project area and over project cycle. Special considerations involving land and water interrelationships, environmental laws and regulations

UNIT-V

Strategies for Successful Infrastructure Project Implementation: Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects. Governments Role

in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

Suggested readings:

1. Grigg, Neil, "*Infrastructure Engineering and Management*", Wiley, 1988.
2. Hudson, Hasnuddin, *"Infrastructure Management: Integrating Design, Construction,Maintenance, Rehabilitation and Renovation",* McGraw Hill, 1997.
3. Anjaneyulu, Y &Manickam, V, *"Environmental Impact Assessment Methodology"*. B.S.Publications, Hyderabad, 2012.
4. P. Chandra, *"Projects: Planning, Analysis, Selection, Financing, Implementation andReview"*, Tata McGraw-Hill, New Delhi, 2009.
5. A. S. Goodman and M. Hastak, *"Infrastructure Planning Handbook: Planning, Engineeringand Economics",* McGraw-Hill, New York, 2006.

OPEN ELECTIVE III

Course Code	Course Title						Core / Elective
OE405EE	**SMART BUILDING SYSTEMS**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- To understand the basic blocks of Building Management System.
- To design various sub systems (or modular system) of building automation
- To integrate all the sub systems

Course Outcomes:

Student will be able to

- Describe the basic blocks and systems for building automation
- Use different subsystems for building automation and integrate them
- Understand basic blocks and systems for building automation
- Design different systems for building automation and integrate those systems

UNIT – I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT – II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT – III

Access Control System: Access Components, Access control system Design.

CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications.

UNIT – IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.

Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control –DAC, MAC, RBAC.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT – V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.

Building Management System: IBMS (HVAC, Fire &Securi-ty) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Suggested Readings:

1. Jim Sinopoli, *Smart Buildings*, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs),* R.S. Means Company Publishing, 1991.
3. Albert Ting-Pat So, WaiLok Chan, Kluwer, *Intelligent Building Systems*, Academic publisher,3rd ed., 2012.
4. Robert Gagnon, *Design of Special Hazards and Fire Alarm Systems*, Thomson Delmar Learning; 2nd edition, 2007.
5. Levenhagen, John I.Spethmann, Donald H, *HVAC Controls and Systems*, McGraw-Hill Pub.
6. Hordeski, Michael F, *HVAC Control in the New Millennium*, Fairmont press, 2001.
7. Bela G. Liptak, *Process Control-Instrument Engineers Handbook*, Chilton book co.

Course Code	Course Title						Core / Elective
OE406EE	**PROGRAMMABLE LOGIC CONTROLLERS**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- To be able to understand basics of Programmable logic controllers, basic programming of PLC.
- To make the students to understand the Functions and applications of PLC

Course Outcomes:

Student will be able to

- Develop PLC programs for industrial applications.
- Acquire the knowledge of PLC counter functions and PLC Arithmetic functions and data handling functions.

UNIT – I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPUs and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures - Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams - Devices to which PLC input and output modules are connected - Input on/off switching devices - Input analog devices - Output analog on/off devices and output analog devices.

UNIT – II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions - Sequence listings - Large process ladder diagram constructions.

UNIT – III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT – IV

Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock - PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic comparison functions and applications - Numbering systems and number conversion functions - PLC conversion between decimal and BCD-Hexadecimals numbering systems.

UNIT – V

Data Handling Functions: The PLC skip and master control relay functions - Jump functions - Jump with non return - Jump with return. PLC data move Systems - The PLC functions and applications. PLC functions working with bits - PLC digital bit functions and applications - PLC sequence functions - PLC matrix functions.

Suggested Readings:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice Hall of India Private Limited, Fifth edition, 2003.
2. Frank D. Petruzella, *Programmable Logic Controllers*, 5th Edition, Mc-Graw Hill, 2019.

Course Code	Course Title						Core / Elective
OE431AE	**AUTOMOTIVE MAINTENANCE**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- To study basic types of vehicle maintenance along with its importance
- To understand the trouble diagnosis procedure for electrical and electronic systems in automobiles
- To acquaint with various Trouble shooting, fault tracing practices available in automobile industry
- To understand the maintenance procedure for air-conditioning in automobiles.

Course Outcomes:

Student will be able to

- Demonstrate the maintenance procedure for automotive Engine.
- Illustrate the trouble diagnosis procedure for electrical systems like Battery, Starting Systems
- Identify the trouble diagnosis procedure for steering and suspension system
- Illustrate trouble diagnosis procedure for lubrication and fuel delivery system etc.
- Explain trouble diagnosis procedure for heating system of automobile.

UNIT – I

Maintenance, Workshop Practices, Safety and Tools: Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis.

vehicles, fire safety - First aid. Basic tools –Scheduled maintenance services – service intervals - Towing and recovering.

UNIT – II

Engine and Engine Subsystem Maintenance: introduction engine IC Engine General Engine service- cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management. **S**ervice - fault diagnosis- servicing emission controls.

UNIT – III

Transmission and Driveline Maintenance: Clutch- general checks, adjustment and service- road testing, Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT – IV

Steering, Brake, Suspension and Wheel Maintenance: Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage.

UNIT – V

Auto Electrical and Air Conditioning Maintenance: Maintenance of batteries, starting system,

charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Suggested Readings:

1. Ed May, "*Automotive Mechanics Volume One*", McGraw Hill Publications, 2003.
2. Ed May, "*Automotive Mechanics Volume Two*", McGraw Hill Publications, 2003
3. *Vehicle Service Manuals of reputed manufacturers*
4. *Bosch Automotive Handbook*, Sixth Edition, 2004

Course Code	Course Title						Core / Elective
OE431ME	**MECHATRONICS**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

Student has to understand the

- How to identify, formulate, and solve engineering problems
- The design a system, component, or process to meet desired needs within realistic constraints
- The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
- The use of drive mechanisms and fluid power systems
- The use of industrial electronic devices
- The demonstrate the design of modern CNC machines, and Mechatronics elements

Course Outcomes:

At the end of the course, the students will be able to

- Model and analyse electrical and mechanical systems and their inter connection
- Integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems
- Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
- Be proficient in the use of fluid power systems in various Mechatronics applications
- Demonstrate the use of industrial electronic devices
- Demonstrate the design of modern CNC machines, and Mechatronics elements

Unit-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

Unit-II:

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

Unit-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro pneumatic circuits

Unit-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to microprocessor & micro controller, Temperature measurement interface and LVDT interface, Systems response

Unit-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLCprogramming

Suggested Reading:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, PearsonEducation
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi,1998
3. Michaels Histand& David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill InternationalEdition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, CengageLearning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, NewDelhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications,Butterworth-Heinemann

Course Code	Course Title						Core / Elective
OE403CE	**ROAD SAFETY ENGINEERING**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- Introduce various factors considered for road safety and management
- Explain the road safety appurtenances and design elements
- Discuss the various traffic management techniques

Course Outcomes:

At the end of the course, the student will be able to

- Prepare accident investigation reports and database
- Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools
- Manage traffic including incident management
- Apply crash reduction techniques
- Design of urban Infrastructure considering safety aspects

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Road Safety in planning and Geometric Design: Vehicle And Human Characteristics, Road Design and Road Equipment's, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT – IV

Traffic Signals & Road signs: Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMT Vehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

References:

1. L.R. Kadiyali and N.B. Lal, “Principles and Practice of Highway Engineering”, New Delhi, 2006
2. Myer Kutz, “Hand Book of Transportation Engineering”, Editor McGraw Hill, 2004.
3. Kadiyali, L. R. "Traffic Engineering and Transport Planning”, Khanna Publishers, New Delhi, 2006
4. Guidelines on Design and Installation of Road Traffic Signals, IRC: 93.
5. Specification for Road Traffic Signals IS: 7537-1974.

Course Code	Course Title						Core / Elective
OE404IT	**SOFTWARE ENGINEERING**						**OE -III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**		**-**	**30**	**70**	**3**

Course Objectives:

- To introduce the basic concepts of software development processes from defining a product to shipping and maintaining
- To impart knowledge on various phases, methodologies and practices of software development
- To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics

Course Outcomes:

Student will be able to

- Acquired working knowledge of alternative approaches and techniques for each phase of software development
- Judge an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS.
- Creation of visual models to describe (non-) algorithmic solutions for projects using various design principles.
- Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.

UNIT – I

Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT – II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT – III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

Suggested Readings:

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw Hill, 2009

2. Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, OxfordUniversity Press, 1996

3. Pankaj Jalote, An Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House, 2008

Course Code	Course Title						Core / Elective
PW402CE	**PROJECT WORK - II**						**CORE - PROJECT**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	-	**-**		**12**	**50**	**100**	**6**

Objectives

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Outcomes:

- Analyse the specific problem using engineering knowledge to arrive at a solution methodology
- Formulate an investigation procedure and analyze, interpret, and synthesize the obtained data using a laboratory procedure and/or modern engineering software and tools.
- Draw valid conclusions and engineering solutions including design, recommendations, or estimations, keeping in view the safety norms and regulations in codes of practice.
- Discuss and communicate in oral and written forms, the technical contents of the project, observing professional ethical principles of documentation.
- Demonstrate individual and teamwork skills in carrying out and managing the project work

CoursePlan

1. In depth study of the topic assigned in the light of the preliminary report prepared in the VII semester
2. Review and finalization of the approach to the problem relating to the assigned topic
3. Preparing a detailed action plan for conducting the investigation, including team work
4. DetailedAnalysis/Modelling/Simulation/Design/ProblemSolving/Experimentasneeded
5. Final development of product / process, testing, results, conclusions and future directions Preparing a paper for Conference presentation/Publication in Journals, if possible
6. Preparing a report in the standard format for being evaluated by the Internal Departmental Committee
7. Final project presentation and viva voce by the faculty coordinator including external expert

Internal Evaluation

Maximum Marks: 50

Evaluation of Project-1 should be based on the progress reported by the student and certified by the supervisor. Evaluation is done based on the students presentation, twice in the semester ie. mid semester evaluation and end semester evaluation. Sessional marks are awarded by the evaluation committee comprising of two faculty members and the supervisor. Marks are allotted based on the students presentation, Report preparation and students ability to answer the questions raised by the examiners.

Distribution of marks	Activity	Weightage
Mid semester evaluation (25)	Supervisor	**10**
	Examiners	**15**
End semester evaluation (25)	Supervisor	**10**
	Examiners	**15**

Distribution of marks for the Project final is as follows:
(i) Two progress assessments:**20 marks** by the faculty supervisor(s)
(ii) Assessmentsandfinalprojectreport:**30marks**bytheinternalfacultycoordinator/reviewcommittee

ExternalEvaluationbyUniversityappointedexternalexaminerMax imumMarks: 100

Distribution of marks for the Project final is as follows:

(i) Project presentation and viva voce : 50 marks
(ii) Project Report Assessment : 50 marks

Note: All the three evaluations are mandatory for course completion and forwarding the final grade.